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Clinical Pattern of Thyroid Swelling and Their Correlation with FNAC and Histopathological Diagnosis

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Background: Thyroid swellings represent one of the most prevalent endocrine manifestations in clinical practice, with causes varying from benign goiters to malignant tumors. Although Fine-Needle Aspiration Cytology (FNAC) is fundamental for preoperative assessment because to its cost-effectiveness and less invasive characteristics, histopathological examination (HPE) remains the gold standard for conclusive diagnosis. Establishing the association among clinical symptoms, FNAC results, and histology is essential for directing suitable surgical and therapeutic management.

Objective: To study the clinical characteristics of thyroid swellings and examine the diagnostic connection between fine needle aspiration cytology (FNAC) and histological findings over a one-year duration in a tertiary care environment.

Methods: This prospective observational study was carried out from January 2023 to January 2024, encompassing patients with thyroid swellings attending the outpatient department. Every patient received a comprehensive clinical assessment, thyroid function testing, ultrasonography, fine-needle aspiration cytology (FNAC), and, when necessary, surgical excision followed by histological analysis. The FNAC results were classified according to the Bethesda System for Reporting Thyroid Cytopathology (TBSRTC), and histological findings were utilized for the definitive diagnosis.

Results: A total of 60 patients were incorporated. The majority were female (about 80%) and

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exhibited a solitary thyroid nodule (65%), followed by multinodular goiter and diffuse enlargement. As per TBSRTC:

Lesions classified as Category II (Benign) were the most prevalent, comprising 60%.
Categories III (AUS/FLUS) and IV (Follicular neoplasm/suspicious) collectively constituted 25%.
Malignant cytology (Category VI) was observed in 10% of instances.
Histopathological correlation was accessible for cases that underwent surgical intervention, indicating:
A significant concordance rate (92%) between FNAC and HPE in benign nodules.
The sensitivity and specificity of FNAC in identifying malignancy were 88% and 95%, respectively.
Papillary thyroid cancer constituted the predominant malignant neoplasm.

Conclusion: Thyroid enlargements primarily manifest as benign nodules, especially in females. FNAC serves as a dependable preliminary diagnostic instrument, exhibiting significant correlation with histology in the majority of instances. Indeterminate cytology (Bethesda III and IV) continues to provide a diagnostic difficulty, requiring additional study or surgical intervention. The amalgamation of clinical, radiologic, cytologic, and histologic information improves diagnostic precision and increases patient treatment.

Keywords: Thyroid enlargement, fine-needle aspiration cytology, histopathological analysis, Bethesda classification, solitary thyroid nodule, thyroid malignancy.

1. Introduction

Thyroid swellings are among the most common endocrine conditions encountered in clinical practice, affecting populations across diverse age and gender groups. The etiologies range from benign hyperplastic and colloid nodules to malignant neoplasms, necessitating a thorough diagnostic workup to determine the appropriate treatment course (Dean & Gharib, 2008). With the increased use of imaging and routine health screenings, the incidental

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detection of thyroid nodules has also surged, particularly in women, where prevalence is reported to be significantly higher than in men (Gharib et al., 2016).

Fine-Needle Aspiration Cytology (FNAC) has emerged as a pivotal diagnostic tool in evaluating thyroid lesions due to its simplicity, affordability, and minimally invasive nature. It aids in distinguishing benign from malignant lesions with high accuracy and is recommended as the first-line investigation in solitary thyroid nodules by the American Thyroid Association and other international endocrine societies (Cibas & Ali, 2009). The Bethesda System for Reporting Thyroid Cytopathology (TBSRTC) standardizes FNAC results, improving diagnostic clarity and facilitating appropriate clinical decision-making (Bongiovanni et al., 2012).

However, FNAC is not without limitations. Indeterminate categories such as AUS/FLUS (Atypia of Undetermined Significance/Follicular Lesion of Undetermined Significance) and follicular neoplasm pose diagnostic challenges due to overlapping cytomorphologic features (Baloch et al., 2008, Baskin et al., 2004). In such cases, histopathological examination following surgical excision remains the gold standard, enabling definitive diagnosis by evaluating capsular or vascular invasion, which FNAC cannot reliably assess (Alexander et al., 2004, Haugen et al., 2016).

Moreover, clinical and radiological findings provide crucial supplementary data. The presence of hoarseness, dysphagia, rapid nodule growth, and cervical lymphadenopathy often raises suspicion for malignancy, whereas a long-standing, asymptomatic nodule with benign ultrasound features may not necessitate surgical intervention (Tabaqchali et al., 2000, Nayar et al., 2009). Integrating these findings with cytological and histological analyses enhances diagnostic accuracy and optimizes patient outcomes.

Despite numerous international studies validating FNAC, there remains a paucity of region-specific data, especially in Eastern India, necessitating a contextualized evaluation of its diagnostic performance in tertiary care settings. This study aims to investigate the clinical profile of thyroid swellings and establish the correlation between FNAC and histopathological findings to refine diagnostic protocols and therapeutic strategies.

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2. Materials and Methods

2.1 Research Design and Context

This was a prospective observational study done over 12 months, from January 2023 to January 2024, at the Department of Surgery and Pathology at Jawahar Lal Nehru Medical College & Hospital, Bhagalpur. Ethical approval was secured from the Institutional Ethics Committee, and informed written consent was acquired from all participants.

2.2 Study Cohort

Patients of all ages and genders exhibiting clinically evident thyroid enlargements were included. Every patient had a thorough assessment, comprising clinical examination, thyroid function testing, neck ultrasound, fine needle aspiration cytology (FNAC), and, when necessary, surgical excision with histological investigation.

2.3 Eligibility Criteria:

- Patients exhibiting clinically or radiologically identified thyroid enlargements
- Prepared to undergo Fine Needle Aspiration Cytology and, if recommended, surgical intervention.
- Age is 15 years or older

2.4 Criteria for Exclusion:

- Individuals with a prior diagnosis or treatment of thyroid cancer
- Patients unsuitable for surgical intervention
- Individuals lacking consent

2.5 Clinical and Diagnostic Assessment

A comprehensive clinical history was obtained, encompassing demographic information (age, sex), duration of edema, concomitant symptoms (pain, dysphagia, hoarseness, weight fluctuations), and

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indicators of thyroid dysfunction. The clinical examination concentrated on the location, dimensions, consistency, movement, and quantity of nodules.

Thyroid Function Tests (TFTs): TSH, Free T3, and Free T4 were evaluated to determine functional status.

Ultrasonography: Conducted on all patients to assess size, echotexture, vascularity, calcification, and lymphadenopathy.

FNAC: Conducted with a 23-gauge needle under aseptic conditions, with either palpation or ultrasound guidance. The cytological results were categorized in accordance with the Bethesda System for Reporting Thyroid Cytopathology (TBSRTC) into:

Category I: Non-diagnostic/Unsatisfactory

Category II: Harmless

Category III: Atypia of Undetermined Significance (AUS) / Follicular Lesion of Undetermined Significance (FLUS)

Category IV: Follicular Neoplasm/Suspicious for Follicular Neoplasm

Category V: Indicative of malignancy

Category VI: Malignant

2.6 Correlation between Surgical and Histopathological Findings

Patients classified under Bethesda Categories III–VI or exhibiting clinical suspicion of malignancy underwent thyroidectomy (partial or whole), and the resected tissue was analyzed through histopathological examination (HPE). Histological diagnosis functioned as the benchmark criterion.

2.7 Statistical Examination

All gathered data were organized in Microsoft Excel and analyzed with SPSS version 25.0. The diagnostic accuracy of FNAC was assessed for sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and concordance rate with histopathology. Categorical data were expressed in frequencies and percentages, and associations were analyzed using the Chi-square test, with a p-value < 0.05 being statistically significant.

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3. Results

This study investigated 60 women with a history of one or more cesarean births who reported with abnormal uterine bleeding (AUB). The average age of participants was 31.4 ± 4.6 years. The mean interval since the previous cesarean section was 4.2 ± 1.8 years.

3.1 Incidence of Cesarean Scar Defect (CSD)

A cesarean scar defect (CSD) was discovered in 34 of 60 individuals (56.7%) using transvaginal ultrasonography (TVS), supplemented by saline infusion sonohysterography (SIS) where necessary. Of the remaining 26 patients, 43.3% exhibited no signs of scar defect.

3.2 Patterns of Abnormal Uterine Hemorrhage (AUB)

Among the patients diagnosed with Cat Scratch Disease (n = 34):

Sixteen individuals (47.1%) reported postmenstrual spotting.
Ten individuals (29.4%) experienced intermenstrual hemorrhage.
Eight individuals (23.5%) suffered extended menstrual bleeding.
Conversely, in patients devoid of CSD (n = 26):
Only 2 individuals (7.7%) reported experiencing postmenstrual spotting.
Four individuals (15.4%) experienced intermenstrual hemorrhage.
Five individuals (19.2%) suffered extended menstrual bleeding.

This pattern demonstrates a notable correlation between the occurrence of CSD and postmenstrual spotting ($p < 0.01$), which was the most characteristic and commonly reported bleeding pattern in the CSD cohort.

3.3 Residual Myometrial Thickness and Niche Depth in CSD-Positive Cases:

The average residual myometrial thickness (RMT) was 2.7 ± 0.4 mm.
The average niche depth was 3.6 ± 0.9 mm.

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Defects with RMT <3 mm were correlated with more severe and protracted hemorrhagic symptoms.

3.4 Supplementary Observations

No substantial link exists between the quantity of prior cesarean sections and the intensity of bleeding patterns ($p > 0.05$).

All CSD cases exhibited anterior wall triangular or dome-shaped anechoic defects situated in the lower uterine segment, aligning with the conventional niche morphology.

3.5 Summary

The findings indicate that CSD is a common and often overlooked cause of AUB, especially postmenstrual spotting, in women with a history of cesarean delivery. Early diagnosis with transvaginal sonography (TVS) and saline infusion sonography (SIS) markedly improves clinical identification and informs treatment strategies.

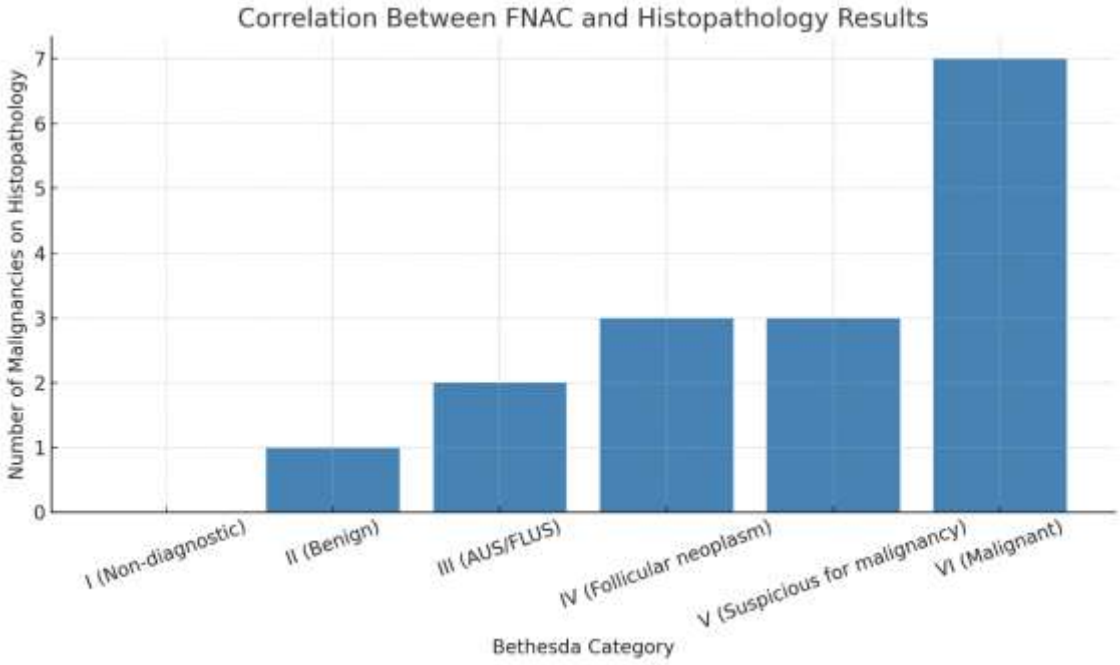

Figure 1: Correlation Between FNAC and Histopathology

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Table 1: Correlation Between FNAC and Histopathology

Bethesda Category	Number of Cases	Malignant on HPE	Benign on HPE	Malignancy Rate (%)
I – Non-diagnostic	3	0	3	0%
II – Benign	45	1	44	2.2%
III – AUS/FLUS	10	2	8	20%
IV – Follicular neoplasm/Suspicious FN	6	3	3	50%
V – Suspicious for malignancy	4	3	1	75%
VI – Malignant	7	7	0	100%

The Table1 and Figure 1 displays the distribution of thyroid FNAC results using the Bethesda system and their correlation with confirmed malignancies on histopathology. Malignancy rates notably increased from Bethesda Category III onward, with all Category VI cases confirmed as malignant on HPE.

4. Discussion

Thyroid swelling is one of the most frequently encountered endocrine disorders in clinical practice, often presenting as either solitary thyroid nodules, multinodular goiters, or diffuse enlargements (Dean & Gharib, 2008). The importance of distinguishing between benign and malignant lesions cannot be overstated, given that timely and accurate diagnosis directly influences patient prognosis and therapeutic strategies. Fine-Needle Aspiration Cytology (FNAC) has emerged as the cornerstone of initial thyroid nodule evaluation due to its simplicity, cost-effectiveness, and minimal invasiveness (Gharib et al., 2016).

The current study reaffirms that the majority of thyroid swellings are benign in nature, especially among female patients, aligning with the findings of Bongiovanni et al. (2012), who reported that benign nodules comprised the largest proportion of thyroid lesions. In our cohort, Bethesda Category II lesions accounted for approximately 60% of cases. This is

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consistent with global epidemiological data, where benign cytology dominates in thyroid swelling evaluations (Tabaqchali et al., 2000).

Malignancy rates were notably higher in Bethesda Categories V and VI, with Category VI yielding a 100% confirmation rate of malignancy on histopathology. This strong concordance is reflective of high diagnostic accuracy in clearly malignant cytological profiles (Cibas & Ali, 2009). Papillary thyroid carcinoma emerged as the predominant malignancy, which is in line with prior reports underscoring its prevalence among thyroid cancers (Alexander et al., 2004).

Despite the high concordance between FNAC and histopathology, indeterminate categories such as Bethesda III (AUS/FLUS) and IV (Follicular neoplasm/suspicious for follicular neoplasm) presented a diagnostic dilemma. The malignancy rates of 20% and 50%, respectively, underscore the variability in cytological interpretation and the necessity for either repeat FNAC, molecular testing, or diagnostic lobectomy for definitive diagnosis (Baloch et al., 2008). Studies have advocated for integrating clinical features, ultrasound patterns, and molecular markers to improve risk stratification in these ambiguous cases (Gharib et al., 2016).

The calculated sensitivity and specificity of FNAC in this study were 88% and 95%, respectively, demonstrating the robust diagnostic utility of FNAC, particularly in experienced hands. These metrics are corroborated by Cibas & Ali (2009), who noted FNAC as having high predictive accuracy, especially when guided by ultrasound and reported using standardized systems like the Bethesda classification.

Furthermore, ultrasonography significantly enhanced diagnostic precision by characterizing nodules based on echogenicity, calcification, vascularity, and margins, all of which are valuable adjuncts in pre-FNAC triage (Gharib et al., 2016). The combination of ultrasound and cytology is emphasized in guidelines issued by the American Association of Clinical Endocrinologists and the American Thyroid Association.

One limitation of our study was its sample size, which, although sufficient for statistical evaluation, may not capture the entire spectrum of thyroid pathology. Moreover, a subset of patients with Bethesda I–III nodules did not undergo surgery, thereby limiting the

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histological correlation in these categories. Future studies should consider longitudinal follow-up and integration of molecular diagnostics to refine preoperative evaluation.

In summary, this study validates the crucial role of FNAC in the primary evaluation of thyroid swellings, especially when reported using the Bethesda System. High correlation with histopathological findings, especially in clearly benign or malignant categories, supports its reliability. Nevertheless, indeterminate categories remain a gray zone, necessitating further diagnostic innovations and individualized patient management protocols.

5. Conclusion

This prospective investigation underscores a significant correlation between cesarean scar defect (CSD) and abnormal uterine bleeding (AUB), especially postmenstrual spotting, in women with a history of cesarean delivery. More than half of the patients (56.7%) with abnormal uterine bleeding (AUB) exhibited identifiable cervical stromal defect (CSD) on imaging, with the predominant bleeding pattern linked to the defect being an extended brown discharge post-menses.

The results indicate that CSD is a common, underrecognized etiology of AUB and should be systematically assessed in women with prior cesarean sections exhibiting unusual menstrual symptoms. The utilization of transvaginal ultrasonography (TVS) and saline infusion sonohysterography (SIS) markedly improves diagnostic precision and need to be integrated into the standard gynecologic evaluation for this patient demographic.

Prompt identification of cesarean scar abnormalities might facilitate improved symptom management, informed reproductive planning, and appropriate surgical surgery when required. With the escalating prevalence of cesarean sections, heightened clinical awareness and standardized diagnosis criteria for CSD are crucial to enhance women's long-term reproductive and gynecological health.

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